

### **REMARKS**

Applicants have amended the claims to include that the oxidation of some of the nitrogen monoxide present in the exhaust gas occurs in the absence of electrical gas discharge. Support for this amendment can be found throughout the specification, for example, at page 1, lines 29-34 and page 2, lines 23-28. No new matter is added by this amendment. Entry of the amendment, and reconsideration of the application as amended is respectfully requested.

Applicants respectfully submit that the present invention as claimed includes an oxidation catalyst in combination with a reduction catalyst comprising a transition metal/zeolite SCR catalyst, where exhaust gas entering the reduction catalyst contains 30 to 70 vol.-% of nitrogen dioxide. Applicants sought to avoid the emission of vanadium compounds from a vanadia/titania SCR catalyst at high exhaust gas temperatures and at the same time provide a catalyst system with an outstanding activity and long-term stability of the SCR-catalyst. The inventors discovered that by employing a special transition metal/zeolite SCR catalyst that there is no emission of vanadia compounds. Further, by adjusting the nitrogen dioxide content of the exhaust gas prior to entering the reduction catalyst, unexpected optimum conversion of the nitrogen oxides is obtained even for an aged catalyst at exhaust gas temperatures as low as 150° C (see Figure 5 of the present application). This effect is, among other things, presumably due to the re-oxidation of the transition metals by nitrogen dioxide and could not be expected (see page 3, lines 9 to 22 of the present application). Unexpectedly, the aged catalyst, for example, performs better at low temperatures than fresh catalyst (compare Figure 3 with Figure 5). None of the cited references disclose, teach or suggest the nitrogen dioxide concentration for a transition metal/zeolite SCR-catalyst as presently claimed.

### **Rejection Under 35 U.S.C. § 103(a) Based on Hammer**

Claims 1-6, and 9-12 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Hammer DE 19820682 (U.S. Patent No. 6,247,303). Applicants respectfully traverse this rejection.

The Examiner alleges that Hammer discloses selective catalytic reduction of exhaust gas using ammonia, and that Hammer also discloses oxidizing nitrogen monoxide to nitrogen dioxide only to a small degree using an oxidation catalyst. The Examiner concludes that it would have been *prima facie* obvious to one of ordinary skill in the art at the time that the invention was made to expect the exhaust gas to contain 30-70 vol. % of nitrogen dioxides before contact with the reduction catalyst. Because of this, the Examiner concludes that Hammer renders the present invention unpatentable.

Applicants respectfully disagree with the Examiner's position. To establish obviousness of a claimed invention, all claim elements must be taught or suggested by the prior art. Hammer specifically requires pretreating the exhaust gas to keep the oxidation of nitrogen dioxide to always below 50% in a non-thermal, normal-pressure gas discharge. Hammer refers to the required non-thermal, normal pressure gas discharge as an electrical gas discharge, Summary of the Invention col. 3, 53-58:

In the invention, a reactor for operating non-thermal normal-pressure gas discharges, also referred to below for short as "gas discharge", such as dielectrically impeded discharges, pulsed discharges or D.C. corona discharges or pulsed glow discharges, and a catalytic converter are connected in series in the direction of flow of the exhaust gas.

Clearly, Hammer requires an electrical gas discharge in combination with a catalytic converter. This combination, according to Hammer, keeps the nitrogen dioxide content always below 50%.

In contrast, the claims as amended specifically exclude the electrical gas discharge that Hammer requires to oxidize the NO to NO<sub>2</sub>. Moreover, the present claims allow the oxidation to occur so that the exhaust gas contains 30 to 70 vol.% of NO<sub>2</sub> before contact with the reduction catalyst. This 30 to 70 vol.% of NO<sub>2</sub> range is not disclosed, taught or suggested by Hammer. In fact, Hammer's range must always be below about 50% (Hammer at col. 4, line 52). Further, Applicants submit, for example, that at a NO/NO<sub>2</sub> volume ratio of 3:1 (compare Figure 4 and Figure 5 of the present application), one of ordinary skill in the art would not expect the break-down of the

conversion rate at this volume ratio as shown in Figure 4, upon reading Hammer. Since Hammer does not disclose, teach, or suggest all of the claim elements, a rejection under 35 U.S.C. §103 is improper, and Applicants request withdrawal of this rejection.

**Rejection Under 35 U.S.C. § 103(a) Based on Hammer and Andreasson**

Claims 7 and 8 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Hammer and WO 99/39809 (Andreasson). Applicants respectfully traverse this rejection.

The Examiner alleges that Hammer discloses a process for the exhaust purification by selective catalytic reduction using ammonia as the reducing substance, and that Hammer discloses that nitrogen oxide is oxidized to nitrogen dioxide only to a small degree by an oxidation catalyst. The Examiner concedes that Hammer does not disclose oxidation catalysts comprising platinum on aluminum oxide. However, the Examiner cites Andreasson for disclosing such oxidation catalysts. The Examiner combines Hammer and Andreasson and concludes that the present claims are unpatentable.

Applicants respectfully disagree with the Examiner's position. As stated above, to establish obviousness of a claimed invention, all claim elements must be taught or suggested by the prior art. Hammer requires the use of an electrical gas discharge in combination with a catalytic converter. This combination, according to Hammer, keeps the nitrogen dioxide content below 50%. Moreover, Hammer does not disclose, teach or suggest any specific oxidation catalyst. All that is disclosed by Hammer is an electrical gas discharge in combination with a catalytic converter.

With regard to Andreasson, this reference discloses a system for NO<sub>x</sub> reduction in combustion gases that incorporates an oxidation catalyst to convert at least a portion of NO to NO<sub>2</sub> for rare earth-based metals SCR catalysts but not transition metal/zeolite SCR catalysts. Andreasson discloses on page 2, lines 18-25:

Desirably, the NO<sub>2</sub>/NO ratio is adjusted according to the present invention to the most beneficial such ratio for the particular SCR catalyst and CO and hydrocarbons are oxidized **prior to the SCR catalyst**. Thus, our preliminary

results indicate that **for a transition metal/zeolite SCR catalyst** it is desirable to convert **all** NO to NO<sub>2</sub>, whereas for a rare-earth based SCR catalyst, a high ratio is desirable providing there is some NO, and for other transition metal-based catalysts gas mixtures are notably better than either substantially only NO or NO<sub>2</sub>. Even more surprisingly, the incorporation of a particulate filter permits still higher conversions of NO<sub>x</sub> (emphasis added).

Clearly, Andreasson discloses conversion of all NO to NO<sub>2</sub> prior to the SCR catalyst and not oxidizing the NO present in the exhaust gas to NO<sub>2</sub> so that the exhaust gas contains **30 to 70 vol.% of NO<sub>2</sub> before contact with the reduction catalyst**. Thus, Andreasson teaches away from the present claims by teaching that for a transition metal/zeolite SCR catalyst, **all** of the NO is converted to NO<sub>2</sub>, not only 30 to 70 vol.% before contact with the reduction catalyst.

As shown in the present application, a NO/NO<sub>2</sub> volume ratio of 1:3 leads to a considerable decrease of conversion rate at low exhaust gas temperatures between 175 and 200° C (compare Figure 6 and Figure 5). Even worse is the situation for a NO/NO<sub>2</sub> volume ratio of 3:1 (compare Figure 4 and Figure 5). Accordingly, when reading Hammer and Andreasson, one of ordinary skill in the art would not expect the breakdown of the conversion rate for this volume ratio as shown in Figure 4. Moreover, one skilled in the art would not combine Hammer with Andreasson, since Andreasson explicitly teaches away from partial oxidation of NO to NO<sub>2</sub> before contact with the SCR catalyst and Hammer explicitly teaches electrical gas discharge.

As stated above, the claims as amended specifically exclude the electrical gas discharge that Hammer requires to oxidize the NO to NO<sub>2</sub>. Moreover, the present claims allow the oxidation to occur so that the exhaust gas contains 30 to 70 vol.% of NO<sub>2</sub> before contact with the reduction catalyst. Applicants submit that neither Hammer nor Andreasson alone or in combination disclose, teach or suggest the present claims. Further, there is no motivation to combine the references in such a way that renders the present claims unpatentable. Therefore, an obviousness rejection under 35 U.S.C. §103 is improper. Applicants request withdrawal of this rejection.

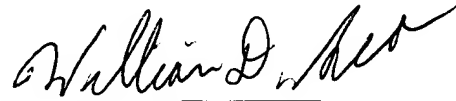
**Conclusion**

In view of the amendments, and the remarks, reconsideration and allowance are respectfully solicited.

Enclosed is the fee for a 3-month extension of time. No additional fee is believed to be due with respect to the filing of this amendment. If any additional fees are due, or an overpayment has been made, please charge, or credit, our Deposit Account No. 11-0171 for such sum.

If the Examiner has any questions regarding the present application, the Examiner is cordially invited to contact Applicant's attorney at the telephone number provided below.

Respectfully submitted,



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